Impact of REACH legislation on European space programmes

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REACH – introduction

Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) [1]

REACH addresses

- the production and use of chemical substances
- their potential impacts human health
- their potential impact on the environment

It is the strictest law to date regulating chemical substances and has worldwide impact.

As a consequence many chemical substances will be 'forced' to be phased out (cost/benefit of continuous use, availability of alternatives) directly affecting the qualification status of materials, processes, and technologies.

The regulation is very desirable and ambitious to contribute to a safer and healthier environment, but it poses wide-reaching engineering challenges for the space sector which is by nature driven by performance and heritage design.

[1] EU Regulation 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the registration, evaluation, authorization and restriction of chemicals (REACH)

REACH – introduction

REACH [1] applies to all chemicals imported or manufactured in the European Economic Area (EU + NOR, ISL, LIE) [2]. It shifts the responsibility for demonstration of safe use of chemicals from authorities to industry. The manufacturing, placing on the market and use of substances in Europe is regulated by processes through:

- Registration
- Authorisation
- Restriction

The candidate list is the baseline tool to identify Substances of Very High Concern (SVHC [3]). SVHCs are gradually included in the Annex XIV of the REACH regulation. Once included in that annex, they cannot be placed on the market or used after a date to be set (the so-called sunset date) unless an authorisation is granted. All uses not authorised have to be phased out.

REACH should be seen as a market opportunity for promoting green technologies.

[1] EU Regulation 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the registration, evaluation, authorisation and restriction of chemicals (REACH)

[2] EU member states ≠ ESA member states, e.g. CH. No bilateral agreement for REACH between CH and EU. Switzerland in process to follow significant aspects of REACH through adaptation of national law.

[3] Categorisation based on inherent properties (criteria from REACH Article 57). The candidate list currently contains 163 entries. By 2020 it is expected to contain all relevant currently known SVHCs (300 – 500 substances).

REACH obsolescence risks - examples

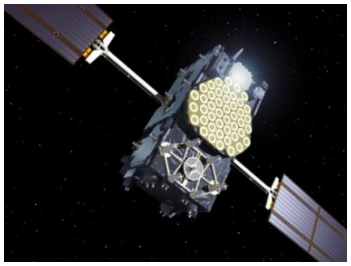
Chromium trioxide
e.g. corrosion protection of Al and Mg alloys
Sunset date 21.9.2017

Ammonium dichromate
Pyrotechnic devices
Sunset date 21.9.2017

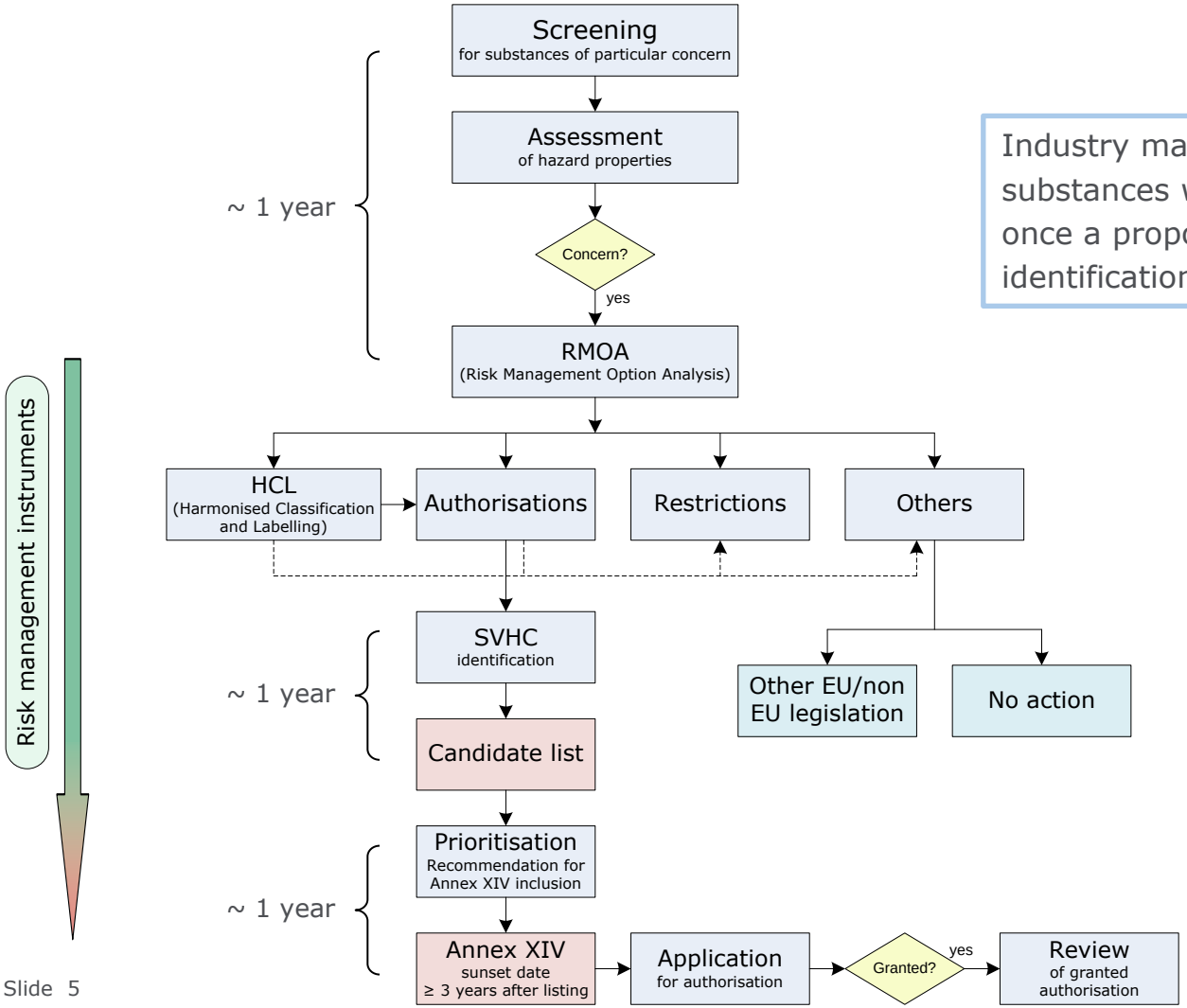
Boric acid
e.g. electrolytic deposition of Ni and SnPb
Sunset date expected Q2 2020

Hydrazine
Propellant for spacecrafts and launch vehicles
Sunset date ≥ Q1 2020

Gallium Arsenide
EEE components and solar cells
CLP, not on authorization route

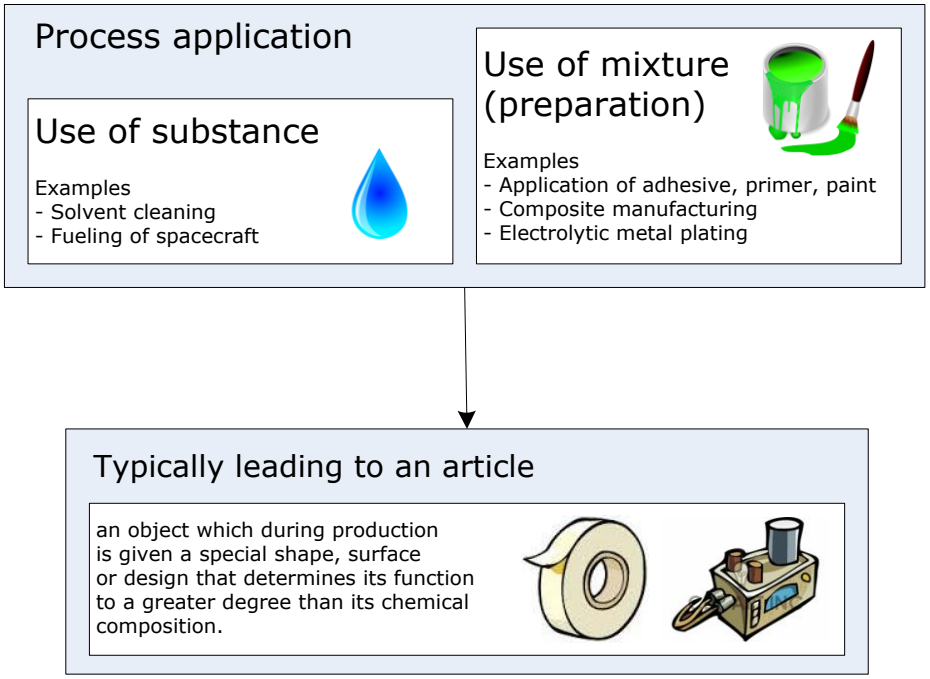


SVHC roadmap and authorisation process



Industry may be forced to phase out substances within 4.5 – 6 years once a proposal for SVHC identification has been initiated.

Typical REACH obligations



REACH obligations if a substance is classified a Substance of Very High Concern (SVHC) or mixture contains SVHC above threshold.

SVHC on candidate list

Suppliers provide Safety Data Sheet

SVHC on Annex XIV

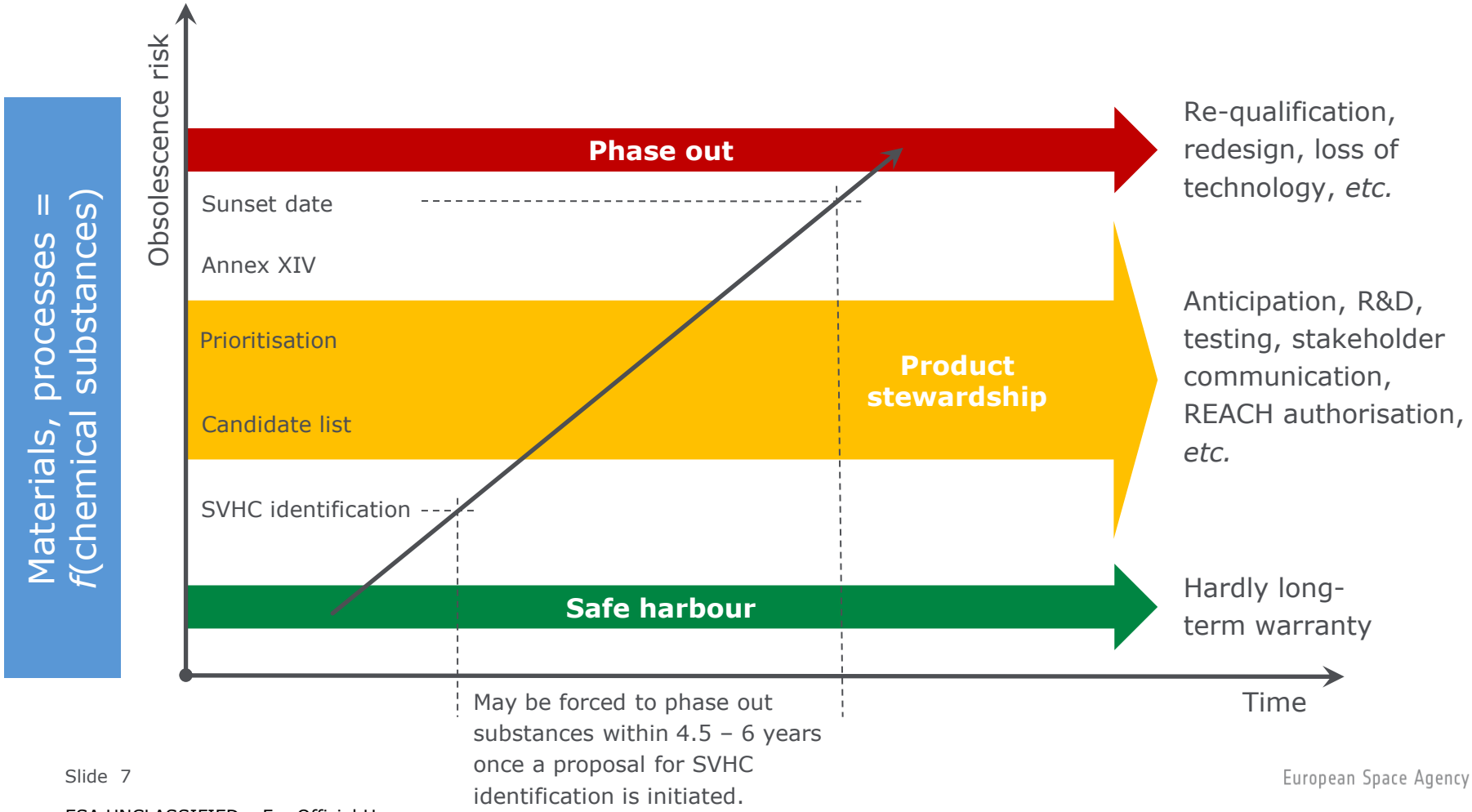
Substance use subject to REACH authorisation

REACH obligations if an article contains a SVHC > 0.1%.

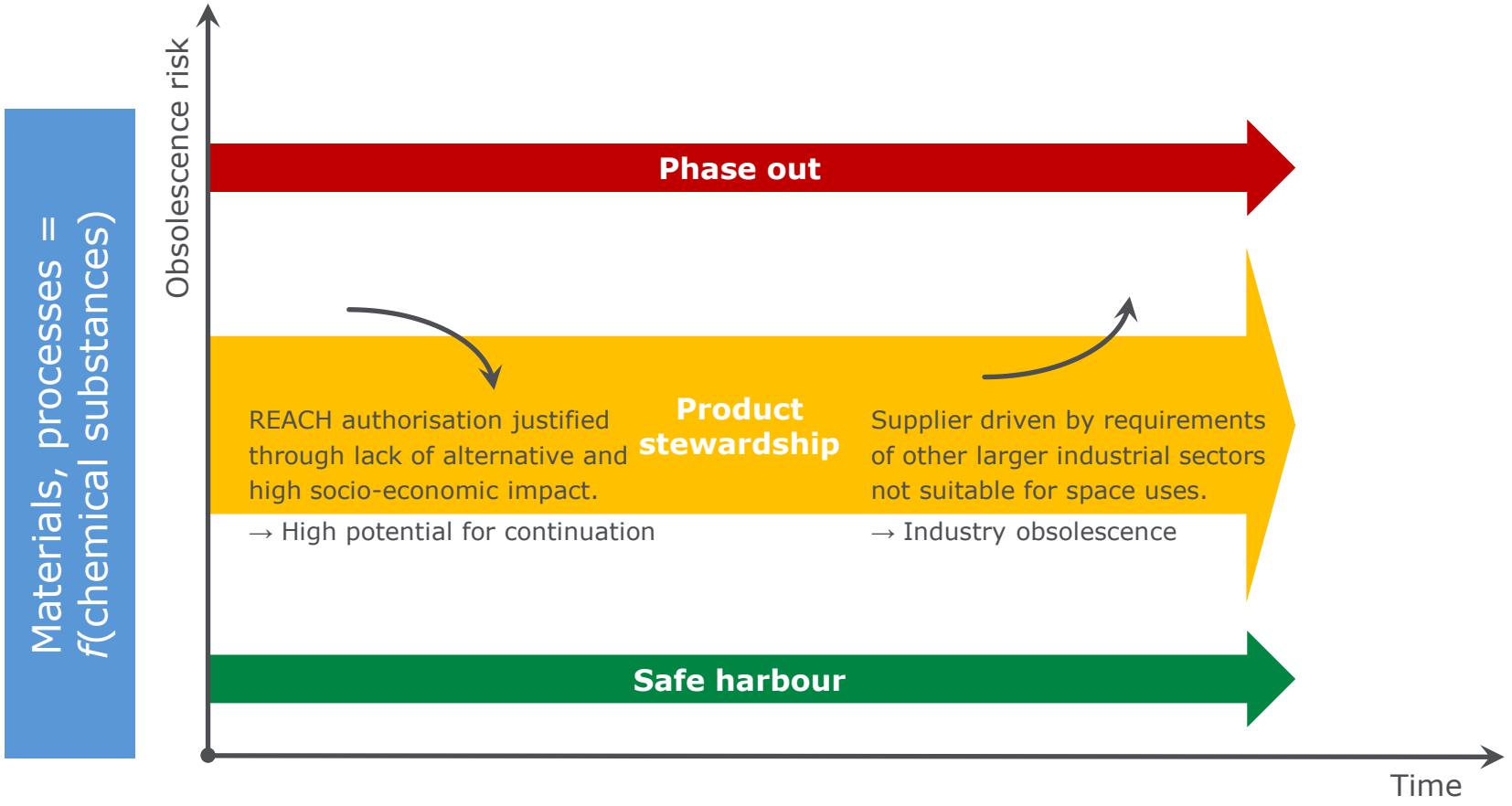
Suppliers to provide sufficient information to allow safe use of the article to customers. Information of ECHA in case substance exceeds quantities totaling 1 t/year.

Articles are not subject to REACH authorisation.

Risks related to life-cycles of substances



Commercial obsolescence vs. REACH



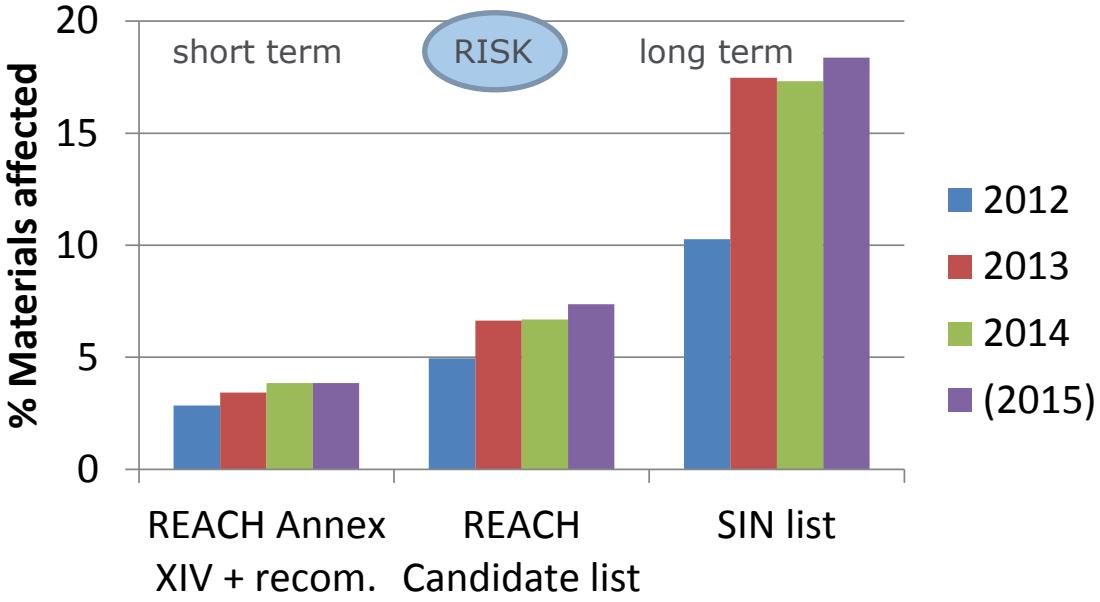
European-wide coordination through MPTB

REACH is affecting European space industry as a whole. Coordination and information exchange of risk analysis and mitigation is to the benefit of the entire community.

The **Materials & Process Technology Board** is a European platform that includes industrial partners and national space agencies including members from Airbus DS, ASI, Avio, CNES, DLR, ESA, Herakles, MAP, OHB, REACHLaw, RUAG, TESAT, and TAS. Tasks include:

- Legislation: Intelligence of legislative processes (e.g. REACH, RoHS) and coordination of actions.
- Obsolescence risk management: Identify in advance critical materials and processes. Propose action plans to mitigate obsolescence risk of Materials & Processes. Reduce programmatic risks and costs by early replacement.
- Data exchange: Share materials test data and avoid test duplication.
- R&D activities: Coordination of R&D activities, monitoring of alerts, analysis of in-orbit anomalies, *etc.*
- Communication & information exchange: Coordination of information via symposia, WGs, training. Development of synergies with other industrial sectors.
- Splinter activities: Chromate space task force, hydrazine task force, European space materials database steering board

Risk assessment



In long-term ~ 20% of our materials may be affected.

Industry may be forced to phase out substances within 4.5 – 6 years once a proposal for SVHC identification has been initiated.

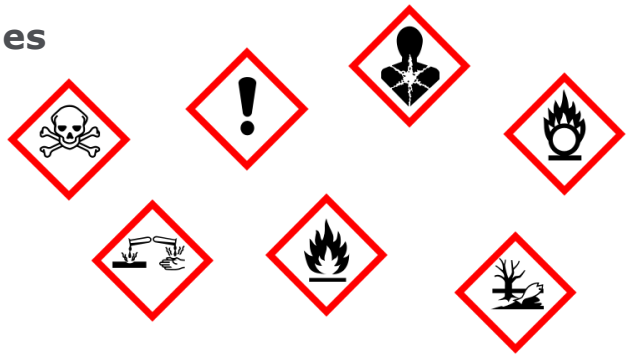
- Perform risk assessment of identified materials and processes taking into account the status in the REACH process, diversity of uses, availability of alternatives, etc.
- Reduce programmatic risks and costs by early replacement
- Propose corrective actions (replacement qualification, R&D, REACH authorisation, exemption etc.)

[1] The SIN list (www.sinlist.org) is an NGO driven project to speed up the transition to a toxic free world. The latest update from Oct 2014 consists of 830 entries. Substances are identified as SVHC based on the criteria established by REACH.

REACH corollary

Directly affects materials, processes and technologies

Adhesive, coating and primer formulations
Solvents, surface treatments
Fuels, energetic materials
EEE components, sensors, PCB assembly
Power generation



- Affects entire industrial sector at unprecedented scale
- Exposure to projects depends on project life
- Affects ground phase from moment of design
- Increasing remedy costs with increasing assembly complexity
- REACH exposure does not end after manufacturing (e.g. fuelling, pyrotechnics, repair, recurrent h/w)
- Legal compliance ≠ risk management
- Space is a niche market

Sustainability of supply chain is at risk, requiring adequate obsolescence management within space community.

Example of Annex XIV – Chromium trioxide

A larger number of chromates are on Annex XIV, most prominent example is CrO_3.

A major use of CrO_3 is in conversion coatings for corrosion protection for Al and Mg alloys (Alodine 1200).

Challenges

Very large diversity of configurations

Replacement is technically very demanding

21 Sep 2017: Sunset date, readiness for qualified alternatives

21 Mar 2016: Latest submission window for REACH authorisation

Intention to bring qualification programs on European/international platform to avoid duplication and give industry access to data.

1.	Replace what can be replaced by Sep 2017	→ Test and qualification campaigns
2.	Ensure authorisation for the remaining for sufficiently long time	→ Prepare authorisation dossier
3.	Are our performance requirements justified?	→ Revisit corrosion requirements

Alodine 1200S replacement – ESA/NASA

Test matrix definition

Substrates (3” x 10”)

- 2024-T3, 2024-T8
- 6061-T6
- 7075-T6, 7075-T73

Configurations

- Pre-treatment only
- Best pre-treatment + primer (both ESA/NASA systems)
- Best Pre-treatment/primer + topcoat (both ESA/NASA systems)

Pre-treatments	Primers	Topcoats
About 20 systems for during pre-screening phase, 4 best performing systems for comprehensive testing:	Combination of 4 primers with 4 best performing pre-treatments	Combination of 4 topcoats with 4 best performing pre-treatment/primer system
Salt spray (168h)	Salt spray (2000h)	Salt spray (2000h)
Humidity exposure (50°C, 80°C/95%rh)	Launch-site exposure	Launch-site exposure
Thermal cycling (± 100°C)	Thermal cycling (± 100°C)	Thermal cycling (± 100°C)
Cleanroom exposure	Adhesion	Adhesion
Surface resistivity		

So far no commercial solution as universal as Alodine 1200, systems are less forgiving and more sensitive to preceding process steps. Especially challenging are 2xxx alloys. Besides corrosion resistance need also to take into account the thermal endurance and surface resistivity

Actions towards sunset date

1. **Testing for replacement of Alodine 1200**

   Coordinated test programs by ESA/NASA , Airbus DS/CNES, ISQ/ESA and individual companies

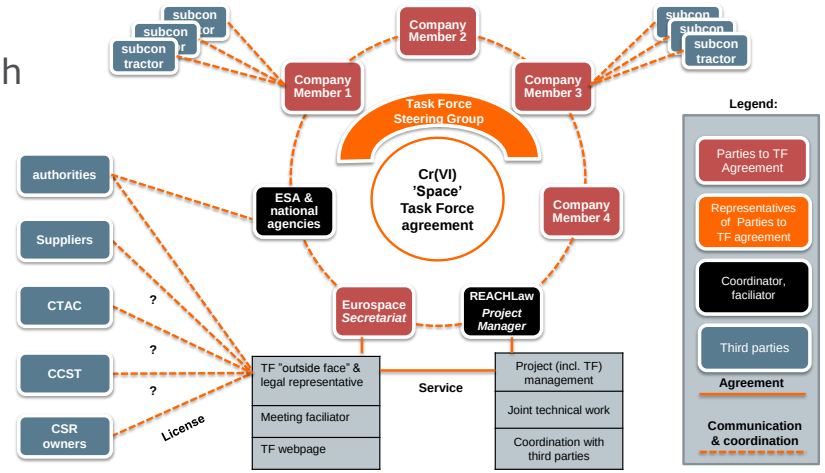
   So far no commercial solution as universal as Alodine 1200, challenges in process control, performance penalties with alternatives, especially difficult are 2xxx alloys.

2. **REACH authorisation**

   Cost-sharing by industry members

   Development of relevant dossier elements through chromate space task force: AoA (Analysis of alternatives), SEA (Socio-Economic Analysis), and substitution plan

   Definition of authorisation strategy including coordination and consultation with CTAC consortium Target latest submission window in Mar 2016 and appropriate revision period.



3. **Development of corrosion standard**

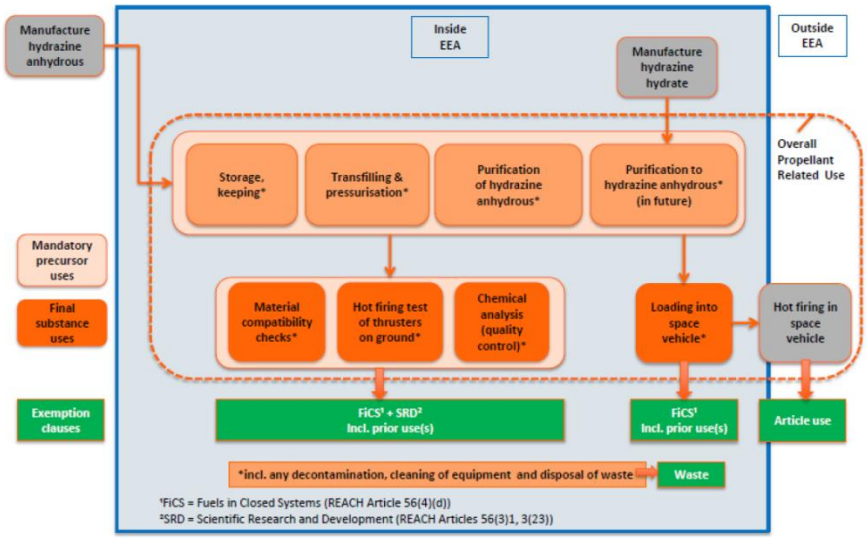
   ECSS-Q-ST-70-14C 'Corrosion' in development

Example of candidate list - hydrazine

1. Exemption

Exemption study indicated this option to be viable. Task force including all stakeholders developed a position paper (http://www.eurospace.org/position-papers.aspx).

Eurospace presented the position paper to the EC end 2012 with the request for legal clarification. While no answer has been received as of today (complexity of the case, precedent nature, need by different DGs to converge on a common view), a response from EC can and should still be expected based on the messages given, which suggest a solid response.



2. Authorisation

Backup solution in case exemption is legally not applicable. Joint socio-economic analysis under development as risk management measure.

3. Development of green alternatives

Independent of the final route, a roadmap towards alternative technology needs to be pursued to

- substantiate the arguments for authorisation/exemption,
- position European space industry on the forefront of green technologies, and provide it with a commercial advantage after successful qualification.

Examples of other critical substances

Substance	Status	Comments, example uses
Trichloroethylene	Annex XIV	Sunset date Apr 2016, primers, degreasing
1,2-Dichloroethane	Annex XIV	Sunset date exp. Q2 2017
Ammonium dichromate	Annex XIV	Sunset date Sep 2017, used in pyrotechnic initiators
Strontium chromate	Annex XIV	Sunset date Jan 2019, corrosion inhibiting primers
N,N-Dimethylacetamide	Annex XIV 4th recom.	Put on hold to await RAC/ SEAC opinions on NMP restriction, residue in polyimides
N,N-Dimethylformamide	Annex XIV 5th recom.	Sunset date exp. Q2 2018, residue in resins
Boric acid	Annex XIV 6th recom.	Sunset date exp. Q2 2020, electrolytic deposition processes
NMP	Candidate list	Restriction process? Residue in adhesives
2-Ethoxyethanol	Candidate list	Primers
2-Methoxyethanol	Candidate list	Primers
Cadmium	Candidate list	Restriction … shall not apply to … articles used in the aeronautical, aerospace … sectors whose applications require high safety standards … Authorisation still possible for unrestricted uses
Lead(II) bis(methanesulfonate)	Candidate list	Electrolytic deposition of SnPb
Isocyanates (MDI, TDI, HDI, etc.)	RMOA concluded	Suggested for restriction
Toluene, MeOH, Lead	RMOA under dev.	TBD
GaAs, InP	CLP	Hazard classification qualifies in principle for SVHC

Future challenges

- **Awareness**
  Challenges to reach all stakeholders including SMEs and other small entities (with limited resources) to ensure awareness and improve visibility to security of complete supply chain.

- **Communication**
  Relevant materials or process information may be proprietary or deep in the supply chain. Supplier alternatives typically driven by requirements from non-space sector.
  Engage in and maintain dialogue within supply chain, upstream and downstream.

  Authorities cannot be expected to have the depth of knowledge to recognise all possible consequences of regulatory decisions. Space community is a niche sector and decisions often driven by needs of larger industry entities.

  Dialogue towards authorities crucial for obsolescence risk mitigation.

- **Significant future investments** will be necessary by industry for
  - **Product replacement**: R&D, testing, qualification, industrialisation
  - **Maintenance of production capabilities**:
    - Compliance to specifications from national/international legislation (not limited to REACH)
    - REACH authorisation for continuation of use (e.g. chromates)
    - Demonstration of compliance with REACH exception clauses (e.g. hydrazine if confirmed by EC)

Conclusions

- In mid-term ~8% materials may be affected, in long-term possibly 20%. Impairment of quality and reliability or even loss of critical technologies through obsolescence of qualified materials and processes must be avoided.
- Active European-wide obsolescence risk management necessary through the Materials and Processes Technology Board (MPTB) as observatory and technical focal point
- Actions are in place to mitigate obsolescence risk for critical substances, including:

  Chromium trioxide (surface treatment): Replacement testing, REACH authorisation, standardisation
  Strontium chromate (primers): Replacement testing
  Ammonium dichromate (pyrotechnics): Replacement testing
  Hydrazine (propellant): Clarification of exemption case, backup REACH authorisation when needed
  Solvents (paints, primers): Monitor legislation, replacement testing when needed
  Boric acid (e.g. electroplating): Impact analysis, replacement actions TBD
  GaAs (EEE components, SA): So far not targeted by REACH, monitor legislation, industry coordination
- Information often hidden in depth of supply chain and proprietary. For risk management it is necessary to raise awareness and stimulate communication upstream/downstream the supply chain.
- SMEs are innovation drivers but often have limited resources to engage in deep long-term risk assessment. Coordination of obsolescence issues with SMEs very challenging.
- Supply chains can be extremely complex, and the authorities cannot be expected to have the depth of knowledge to recognise all possible consequences of regulatory decisions. Communication between authorities and space actors is crucial and the only way to succeed.
- Early replacement of materials/processes containing SVHCs may position European space industry on the forefront of green technologies, and provide it with a commercial advantage after successful qualification.
- Significant future investments are needed by industry and agencies for product replacements and maintenance of production capabilities.

Questions?